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## 9.—The Plantagenet Beds at Hummocks Beach, Bremer Bay, Western Australia


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A thickness of about 60 feet of the Plantagenet Beds, including a basal conglomerate of gneiss and dolerite, is exposed in a cliff at the northern end of Hummocks Beach, Bremer Bay. The sedimentary sequence nonconformably overlies jointed Precambrian gneisses containing clastic dykes composed partly of gneissic and doleritic fragments. The basal conglomerate of the Plantagenet Beds, which is probably not widespread, was deposited in a shore-line environment very like that in which talus is now accumulating at Hummocks Beach.


### Introduction

The Plantagenet Beds were named by Jutson and Simpson (1917) but although references were made to the rocks before and after their work, the first comprehensive account of the geology of the sequence was not published until thirty-seven years later (Clarke and Phillipps 1954). Clarke and Phillipps listed all relevant literature, and cited the then generally accepted opinion that the Plantagenet Beds were Miocene, but recent evidence has indicated an Eocene age (see Glaessner 1953, p. 143, 1955, p. 357; Singleton 1954, p. 62; Cookson 1954; Cookson and Pike 1954; McWhae *et al.* 1958; Glenister and Glover 1958; and Quilty *in* Hodgson *et al.* 1962). Quilty (personal communication) now considers that planktonic foraminifera from deposits at Nannarup and Albany indicate an Upper Eocene age correlating with Carter's faunal unit 2 (Carter 1958). However, field observations have not kept pace with palaeontological advances and the work at Cheyne Bay of Hodgson (1962) and Hodgson *et al.* (1962) represents the only significant contribution to our knowledge of the distribution and lithology of the Plantagenet Beds since the investigation of Clarke and Phillipps. There is, therefore, justification for recording here the hitherto undescribed exposures which occur at the north end of a beach known locally as Hummocks Beach, in Bremer Bay. No fossils have been found in these sedimentary rocks, but their stratigraphic position, and the appearance and lithology of the upper part of the sequence, indicate their continuity with the fossiliferous Plantagenet Beds 6 miles to the north on the Gairdner River. This is borne out by the presence of isolated outcrops in the aeolian sands between Hummocks Beach and the Gairdner River.

The Plantagenet Beds at Hummocks Beach attain a thickness of up to 60 feet and their nonconformity with underlying Precambrian gneisses is clearly exposed in a cliff section. The bottom section, from 5 to 15 feet thick, of the Plantagenet Beds is here made up of a remarkable conglomerate containing boulders of granitic gneiss and highly kaolinized basic rock and the upper section, 45 to 55 feet thick, is composed of claystone. The outcrop of conglomerate extends laterally for about 400 feet and there is no evidence so far to suggest that it has wider extent, or that it occurs elsewhere.

### Access

Hummocks Beach (sometimes also called Peppermint Beach) is most easily approached from Bremer Bay township by crossing the semi-permanent sand bar at the mouth of the Bremer River and following the northerly track that leads to the Gairdner River. This track follows an abandoned telegraph line. Approximately five miles north of the Bremer River bar, an easterly track that leads to Doubtful Island Bay, Point Hood and Hummocks Beach, should be taken. The latter track is sandy in places but is passable by two-wheel drive vehicles driven with care. The tracks are shown on Fig. 1.

### Geology

#### *Regional Geology*

Basement rocks in the area are Precambrian gneisses and granulites of high metamorphic grade. The gneissic foliation trends in the direction 250° and dips steeply south. A dolerite dyke which is about 20 yards wide and trends 330° crops out about 3½ miles east-south-east of the conglomerate location. Basement rocks are overlain in places by the Plantagenet Beds, and elsewhere by aeolian, quartz-rich sand.

#### *The Hummocks Beach Section*

The cliff section at Hummocks Beach exposes up to 12 feet of Precambrian gneiss which is overlain nonconformably by up to 60 feet of


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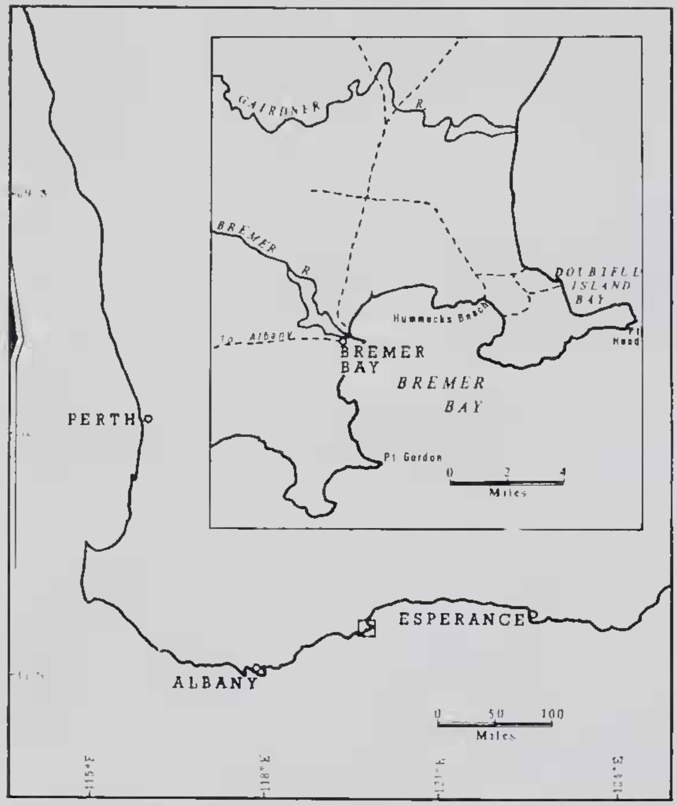


Fig. 1.—Locality map.

the Plantagenet Beds. The original thickness of the Eocene sequence in this area is unknown, but thicknesses of 300 feet (Clarke and Phillipps 1954, p. 4) and 250 feet (Hodgson *et al.* 1962, p. 48) preserved elsewhere indicate that several hundred feet may have been eroded.

*Precambrian Rocks.*—The Precambrian rocks immediately underlying the Plantagenet Beds are poorly banded acid gneisses containing thin bands of basic granulite. Specimen 44811* which is representative of the gneiss, is a grey, greasy looking, medium-grained, poorly banded rock. In thin section it is seen to be a granoblastic aggregate of antiperthitic oligoclase (60%), perthitic microcline (20%), quartz (12%), hypersthene (4%) and augite (3%), with accessory granules of magnetite, apatite and zircon. The pyroxene grains are dispersed throughout the rock, but a tendency for their concentration into bands has resulted in the poorly developed gneissic structure seen in hand specimen. There is evidence of crushing in the rock for the margins of many quartz and feldspar grains are finely granulated.

*Plantagenet Beds.*—The lowermost 5 to 15 feet of the Plantagenet Beds consist of boulder, cobble and pebble conglomerate and the rest is mainly claystone. The largest boulders in the conglomerate are subrounded with diameters of up to 15 feet, and consist of grey, granitic

* Specimen numbers are those of the Department of Geology, University of Western Australia.

Fig. 2.—Basal conglomerate in the Plantagenet Beds showing two large boulders of gneiss with fresh cores and strongly weathered rims.

Fig. 3.—The large light grey boulders, one of which contains darker, unweathered patches, are granitic gneiss. Smaller light grey boulders and cobbles packed between the large boulders consist of kaolinized basic rock.

gneiss. Many of the large boulders of gneiss are weathered marginally to a depth of about one foot (Fig. 2) and smaller fragments are kaolinized throughout. Between the large boulders there is commonly an assemblage of smaller boulders, cobbles and pebbles of soft, highly kaolinized, light grey, basic rock (Fig. 3). In some places the basic fragments are so tightly packed that only about 10 per cent. of the resultant conglomerate is composed of white interstitial cement (Fig. 4). The cement is mainly argillaceous but is locally sandy.

Microscopic examination of crushed fragments of the basic rock reveals cloudy argillaceous material from which quartz is absent or present only sparingly. The texture of selected fragments was made clearer by staining flat surfaces with "malachite green" which colours some clay minerals more deeply than others. Strong indications of porphyritic and ophitic textures are visible when stained surfaces are varnished and examined with a hand lens. In one fragment which probably came from the chilled margin of an intrusion, the relict texture ranges from aphanitic to fine-grained ophitic. These observations leave no doubt that the kaolinized material is dolerite. Soft, white veins which cut some dolerite fragments were probably originally end-stage veinlets.

The conglomerate passes upward into bedded, slightly iron-stained, white, poorly consolidated, sandy claystone (Fig. 5). A thin section of claystone (No. 49917, from 8 feet above the top of the conglomerate) reveals that the specimen consists of finely divided argillaceous material (88%), angular quartz grains, most of which are about 0.2 mm in diameter (7%), and biotite, chlorite and muscovite (4%). Glauconite has not been positively identified but may be present. Other minerals include feldspar, black iron ore and zircon. The claystone is draped irregularly over the large boulders near the top of the conglomerate, but higher in the sequence the bedding is regular and practically horizontal.

Some of the weathered gneiss which is *in situ* beneath the nonconformity contains clastic dykes which extend for several feet and are up to three or four inches wide (Figs. 6, 7). These dykes contain fragments of kaolinized dolerite up to ½-inch in diameter, quartz grains and rare fragments of gneiss, in an argillaceous matrix. Some of the dykes are parallel to joints in the fresh gneiss forming part of the same outcrop and it is clear that these dykes result from the infilling of fissures weathered out along such joints. Some clastic dykes (Fig. 7) branch and

Fig. 4.—This photograph reveals in greater detail the kaolinized basic fragments shown near the centre of Fig. 3. Note the close packing of the fragments, and the white veinlets that transect some of them. The basic fragments are dolerite, and the veinlets are probably end-stage injections (see text).

Fig. 5.—The basal conglomerate is overlain, toward the top of the photograph, by horizontally bedded claystone. Basement gneiss is shown at the bottom of the photograph.

wedge out downward indicating infilling from above of fissures developed along irregular cracks. It is evident that most of the kaolinization of the dolerite took place after the fragments were incorporated in the conglomerate and clastic dykes, for in their present completely kaolinized state the fragments crumble easily and would not survive much movement. It is most likely also that the friable weathered shells around boulders of gneiss formed after their incorporation in the conglomerate. The intense weathering of the conglomerate was most probably effected before its exposure in the present cycle.

**Environment of Deposition of the Plantagenet Beds**

The lithology and texture of the basal conglomerate of the Plantagenet Beds is best explained by assuming that it formed along a shore-line and its environment of deposition in the Hummocks Beach area was probably very like the present environment. At present boulders of gneiss comparable in size and shape to those in the basal conglomerate of the Plantagenet Beds are scattered along the base of the cliff (Fig. 8) and although some have weathered out of the conglomerate, others are clearly forming from the exposed basement rocks. Jointed gneisses are partly exposed and partly covered by sand that doubtless fills many concealed fissures to form embryonic clastic dykes. There were, however, some differences during the deposition of the basal Plantagenet Beds. For example, the gneiss, before its partial erosion to yield boulders for the conglomerate, must have been more strongly outcropping than now and there must have been dolerite outcrop nearby. Furthermore, sea-level relative to the base of the conglomerate was probably 10 or 15 feet higher than at present. Nevertheless, there is little doubt that during the time represented by the conglomerate, waves of the South-

Fig. 6.—Clastic dyke in gneiss near the bottom of the cliff on Hummocks Beach.

Fig. 7.—A clastic dyke in the basement gneiss branches and wedges out downward.

Fig. 8.—A general view of the cliff at Hummocks Beach, with shallow water in the foreground. Note the exposed basement gneiss, the basal conglomerate and the overlying claystone. Boulders of gneiss at the foot of the cliff have come from weathering of the basement rocks and the conglomerate.

ern Ocean beat against the coast in much the same place as they do now at the north end of Hummocks Beach. The change from conglomerate to claystone without an intervening transgressive sandstone phase may be the result of sudden incoming of the sea, rather than gentle eustatic movement. In any case, the sea eventually transgressed large areas of the continent. At first the fine sediments were draped over large boulders at Hummocks Beach, but as irregularities were smoothed out the deposits became essentially horizontal.

### References.


Carter, A. N., (1958).—Tertiary foraminifera from the Aire district, Victoria. *Bull. Geol. Surv. Vict.* 55.

Clarke, E. de C., and Phillipps, H. T. (1954).—The Plantagenet Beds of Western Australia. *J. Roy. Soc. W. Aust.* 39: 1-9.

Cookson, Isabel C., (1954).—The occurrence of an older Tertiary microflora in Western Australia. *Aust. J. Sci.* 17: 37-38.

Cookson, Isabel C., and Pike, Kathleen M., (1954).—Some dicotyledonous pollen types from Cainozoic deposits in the Australia Region. *Aust. J. Bot.* 2: 197-219.

Glaessner, M. F. (1953).—Conditions of Tertiary sedimentation in southern Australia. *Trans. Roy. Soc. S. Aust.* 76: 141-146.

Glaessner, M. F., (1955).—Pelagic fossils (*Aturia*, penguins, whales) from the Tertiary of South Australia. *Rec. S. Aust. Mus.* 11: 353-371.

Glenister, B. F., and Glover, J. E., (1958).—*Teichertia* in the Plantagenet Beds of Western Australia. *J. Roy. Soc. W. Aust.* 41: 84-87.

Hodgson, E. A., (1962).—Origin of glauconite in some sandstones of the Plantagenet Beds, Cheyne Bay, Western Australia. *J. Roy. Soc. W. Aust.* 45: 115-116.

Hodgson, E. A., Quilty, P. J. G., and Rutledge, D. J., (1962).—The geology of the south coast in the vicinity of Cheyne Bay, Western Australia. Thesis, Geol. Dep., Univ. W. Aust.

Jutson, J. T., and Simpson, E. S., (1917).—Notes on the geology and physiography of Albany. *J. Roy. Soc. W. Aust.* 2: 45-58.

McWhae, J. R. H., Playford, P. E., Lindner, A. W., Glenister, B. F., and Balme, B. E., (1958).—The stratigraphy of Western Australia. *J. Geol. Soc. Aust.* 4 (2): 1-161.

Singleton, O. P., (1954).—The Tertiary stratigraphy of Western Australia—a review. *Proc. Pan. Ind. Oc. Sci. Congr.* Sect. C.: 59-65.

# Memorial

## Enid Isabel Allum

In an association of over 40 years with the Royal Society of Western Australia, Miss Allum must be remembered as a most faithful member. Miss Allum's enthusiasm and interest have encouraged members in their scientific endeavours, while her cheerfulness in the face of suffering and disability has inspired them personally.

Miss Allum served the Society as Treasurer from 1920 to 1927 and as Council Member from 1931 to 1936 and in 1952 was elected to Honorary Associate Membership.

A teacher of pianoforte by profession, Miss Allum was also an artist of note, being responsible for the prize-winning design for the Kelvin Medal of the Society.

Miss Allum is remembered in the Society with affection and respect and expressions of sympathy are extended to her relatives and friends.

# Memorial

## Ludwig Glauert

Mr. Ludwig Glauert, one of Western Australia's best known naturalists, passed away on February 8th, 1963, at the age of 84. Ludwig Glauert was born on May 5th, 1879, at Sheffield, England. He arrived in Western Australia in 1908 and commenced work as a field geologist in the Geological Survey, transferring to the Western Australian Museum in 1910 where he served for 46 years. He occupied positions as scientific assistant, keeper of ethnology and geology, Curator and finally Director, working assiduously to overcome administrative and financial difficulties whilst researching into natural history. He carried the Museum to the public by means of contributions to local magazines and newspapers, and introduced Museum classes for schoolchildren, an innovation in Australia at that time.

On his arrival in Western Australia, he joined the Natural History and Science Society of Western Australia, serving as its Secretary in 1908-9 and as Councillor in 1911-12. On his return from military service he joined the Royal Society and the following year was elected to Council and served the Society for many ensuing years as Librarian from 1925-40 and President in 1933-35 and 1947-48. He took a prominent part in the foundation of the Western Australian Naturalists' Club in 1924 and maintained a strong interest in its activities throughout his life.

He was awarded the Australian Natural History Medal in 1948, the Kelvin Medal for his contribution to science in 1954, the Carnegie Award in 1954 and received the M.B.E. in 1960. In 1953. he was made an Honorary Life Member of the Royal Society of Western Australia.